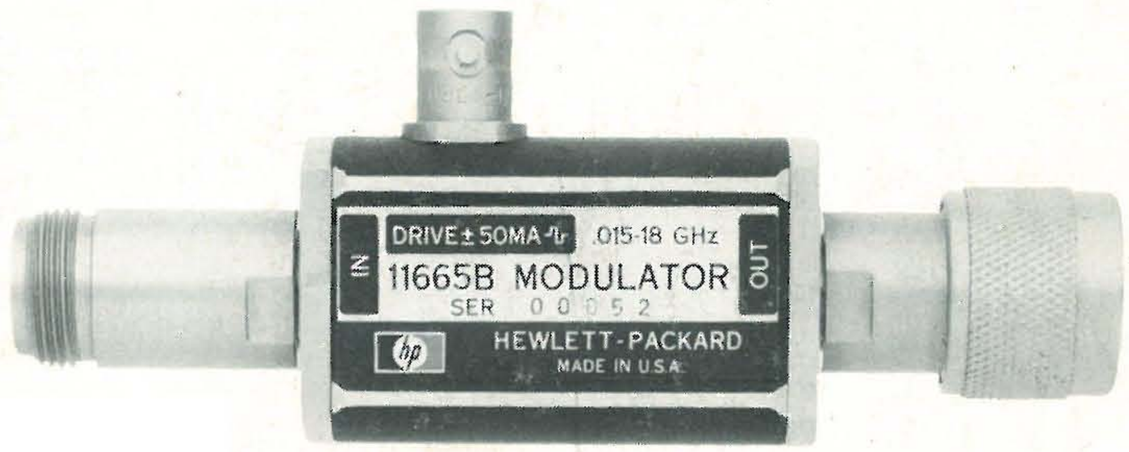
OPERATING AND SERVICE MANUAL

MODULATOR

11665B



JULY 1973

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HP 11665B

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The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

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OPERATING AND SERVICE MANUAL

11665B
MODULATOR

SERIAL NUMBERS

For important information concerning serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I.

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MANUAL PART NO. 11665-90011
Microfiche Part No. 11665-90012

Printed: JULY 1973

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SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION

1-2. This manual contains operating and service information for the Hewlett-Packard Model 11665B Modulator. The Model 11665B is shown in Figure 1-1.

1-3. On the front cover of this manual, below the manual part number, is a "Microfiche" part number. This number may be used to order 4x6-inch microfilm transparencies of the manual. The microfiche package also includes the latest Manual Changes supplement as well as all pertinent Service Notes.

1-4. Instrument specifications are listed in Table 1-1. These specifications are performance standards or limits against which the instrument may be tested. Table 1-2 lists supplemental characteristics. Supplemental characteristics are not specifications but are typical characteristics included as additional information for the user.

1-5. INSTRUMENTS COVERED BY MANUAL

1-6. This manual applies directly to all instruments unless a yellow Manual Changes supplement is included with the manual. An instrument manufactured after the printing of this manual may have changes which do not appear in the manual. The manual for this instrument is supplied with a yellow Manual Changes supplement that contains "change information" that documents the differences.

1-7. In addition to change information, the supplemental contains information for correcting errors in the manual. To keep this manual as current and accurate as possible, Hewlett-Packard recommends that you periodically request the latest Manual Changes supplement. The supplement for this manual is keyed to this manual's print date and part number, both of which appear on the title page. Complimentary copies of the supplement are available from Hewlett-Packard.

1-8. For information concerning a serial number not listed in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

1-9. DESCRIPTION

1-10. The Model 11665B Modulator is designed for squarewave modulation of frequencies between

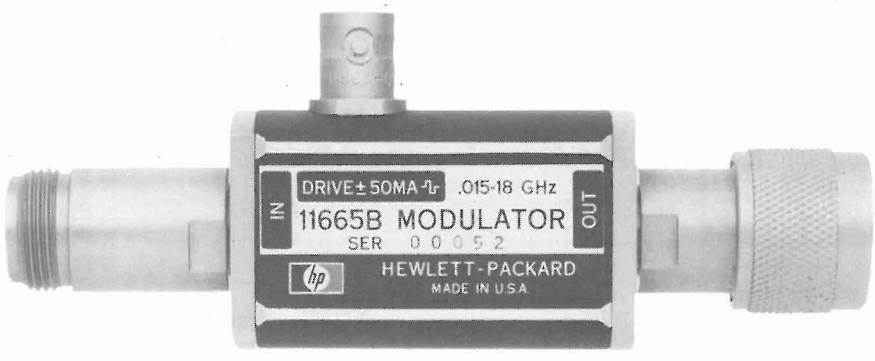


Figure 1-1. Model 11665B Equipment Supplied

15 MHz and 18 GHz. Modulation frequencies up to 100 kHz may be used. The Modulator is a non-reflective 50 ohm load when used within these limits.

1-11. OPTIONS

1-12. The following connectors are available for the Model 11665B.

Option	Input	Output
011	N-Jack	N-Jack
013	N-Jack	APC-7
021	N-Plug	N-Jack
022	N-Plug	N-Plug
023	N-Plug	APC-7

1-13. EQUIPMENT REQUIRED BUT NOT SUPPLIED

1-14. To use the Model 11665B, the following equipment is required:

1. If the 11665B is to be used to test active devices which amplify frequencies below approximately 100 MHz, or at any time where modulation feedthrough may be a problem, a high-pass filter HP Model 11668A should be used. Connect the Model 11668A between the Model 11665B OUT port and the test setup.

2. If the Model 11665B Modulator is used with the Model 8755A Swept Amplitude Analyzer, the Model 8755A furnishes the modulation signal. If the Modulator is used alone, a squarewave modulation source which can furnish approximately 50 mA of current in both positive and negative voltage polarities must be used. Connect the squarewave modulation source to the Model 11665B DRIVE port. Refer to paragraph 4-8 in this manual for further information concerning the requirements of the squarewave modulation source.

1-15. SWEPT AMPLITUDE ANALYZER

1-16. The Model 8755A Swept Amplitude Analyzer with three 11664A Detectors and the Model 11665B Modulator measures amplitude levels of −50 to +10 dBm and amplitude ratios of 60 dB over a frequency range of 15 MHz to 18 GHz. The Model 8755A plugs into the Model 180-series Oscilloscopes.

Table 1-1. Specifications

SPECIFICATIONS

FREQUENCY

Range: 15 MHz to 18 GHz.

IMPEDANCE

Mainline Input and Output Impedance: 50Ω nominal.

Return Loss: (ON or OFF Condition)
.015 to .04 GHz: ≥ 10 dB (≤ 1.92 SWR)
.04 to 4 GHz: ≥ 15 dB (≤ 1.43 SWR)
4 to 8 GHz: ≥ 12 dB (≤ 1.67 SWR)
8 to 18 GHz: ≥ 8 dB (≤ 2.32 SWR)
NOTE: APC-7 connectors typically have ≥ 10 dB return loss from 12.4 to 18 GHz.

TRANSMISSION

Insertion Loss:

Frequency (GHz)	ON Condition	OFF Condition
.015 to .04	≤ 7.0 dB	≥ 35 dB
.04 to 4	≤ 3.2 dB	≥ 35 dB
4 to 8	≤ 3.8 dB	≥ 40 dB
8 to 12.4	≤ 4.3 dB	≥ 45 dB
12.4 to 18	≤ 5.0 dB	≥ 45 dB

POWER

Modulator Drive Feedthru: * ≤ 8 mV (peak) at 27.8 kHz from either input or output ports.

Maximum RF Input: +24 dBm.

GENERAL

Connectors: Standard, N-Jack Input/N-Plug Output

Option	Input	Output
011	N-Jack	N-Jack
013	N-Jack	APC-7
021	N-Plug	N-Jack
022	N-Plug	N-Plug
023	N-Plug	APC-7

NOTE: "Jack" identifies the female connector with fixed threads; "plug" male connector has coupling nut.

Weight: Net, 6 oz. (0,17).

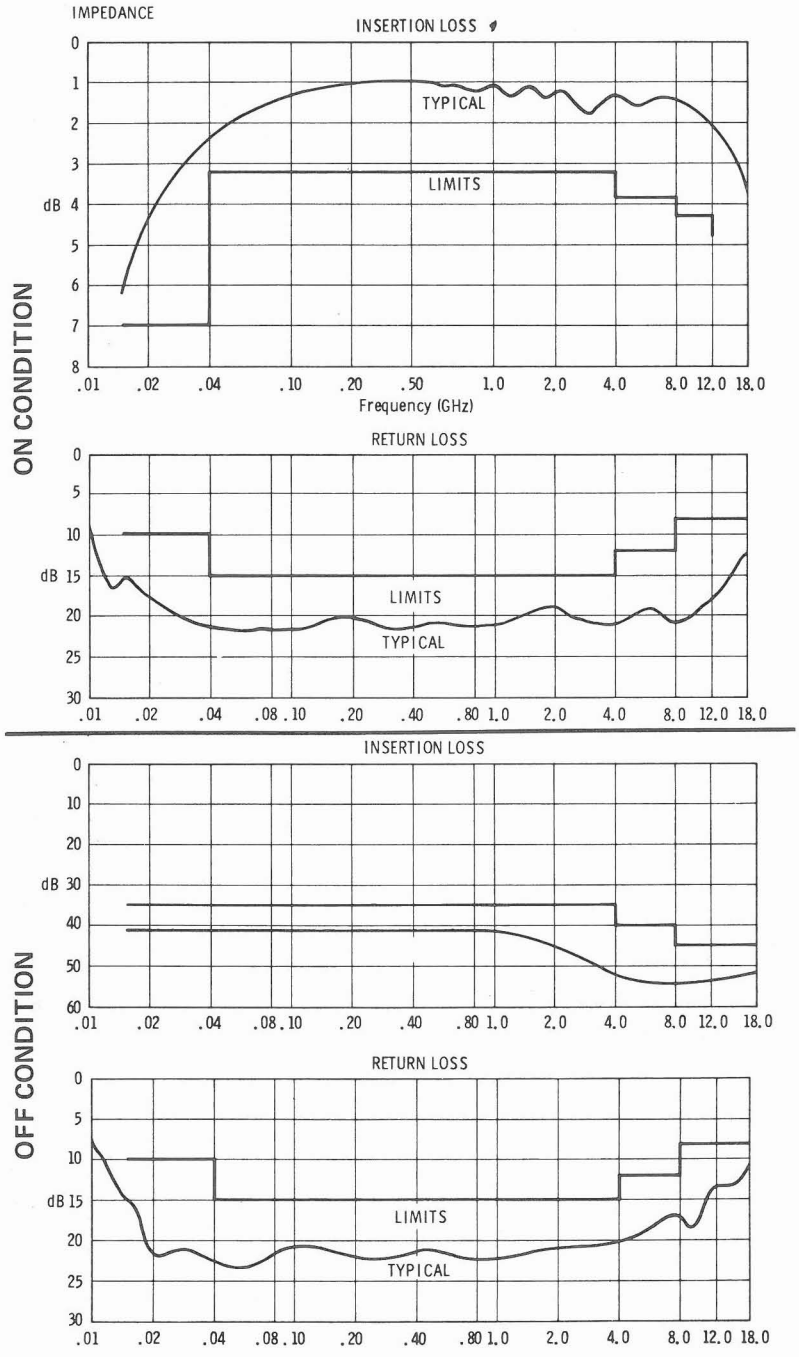
* When Model 11665B Modulator is driven from a Model 8755A

Table 1-2. Supplemental Characteristics

FREQUENCY

Harmonic Generation: Above 1 GHz, typically 40 dB below input power of +10 dBm. Below 1 GHz, typically 30 dB below input power of +10 dBm.

Drive Current: Nominally +50 mA in ON condition, —50 mA in OFF condition.



1-17. Oscilloscope

1-18. The Model 8755A Swept Amplitude Analyzer must be plugged into a Model 180-series Oscilloscope. The Model 180 acts as a display indicator and power supply for the Model 8755A.

1-19. Directional Couplers

1-20. To separate the incident and reflected signals, directional couplers are usually used with the Model 8755A. Either one dual directional coupler or two single directional couplers connected as a dual directional coupler can be used. The sweep frequency of the measurement is limited by the frequency range of the directional coupler.

1-21. Detector

1-22. Three Model 11664A Detectors are needed when using the Model 8755A Swept Amplitude Analyzer. These detectors demodulate the 28.7 kHz modulation signal from the RF Input signal.

1-23. Sweep Oscillator

1-24. Sweep Oscillators are needed to furnish the RF input signal. Either the HP Model 8620-series or Model 8690-series Sweep Oscillators may be used.

1-25. RECOMMENDED TEST EQUIPMENT

1-26. Table 1-3 lists recommended test equipment. This equipment is used in performance testing, and troubleshooting the Model 11665B. Other equipment may be substituted, provided its specifications equal or exceed the specifications given under Critical Specifications.

Table 1-3. Recommended Test Equipment (1 of 2)

Instrument Type	Critical Specifications	Suggested Model	Use*
Sweep Oscillator	Frequency: 100 MHz to 18 GHz Modulation: squarewave, frequency compatible with SWR Meter.	HP Model 8620 mainframe with HP Model 8621A and: 86330A + 86320A (0.1 to 4.2 GHz) 86341B (3.2 to 6.5 GHz) 86342A (5.9 to 9 GHz) 86350A (8.0 to 12.4 GHz) HP Model 8620 mainframe with: 86260A (12.4 to 18 GHz)	P,T
Swept Amplitude Analyzer	Provides 27.8 kHz modulation signal. Powers three 11664A Detectors. Processes and displays the detected signals.	HP 8755A	P,T
BNC Tee	2 female BNC, 1 male BNC connectors.	HP Part No. 1250-0781 (UG-274A/U)	P,T
Modulator	Frequency: 100 MHz to 18 GHz Modulation: 27.8 kHz	HP 11665B	P,T
Dual Directional	Frequency: 100 MHz to 18 GHz Coupling: 20 dB Directivity: ≥ 40 dB	HP 778D (110 MHz to 2 GHz) HP 11692D (2 to 18 GHz)	P,T
Low-Pass Filter	Frequency: Reduces 2nd harmonic of frequency band of interest ≥ 50 dB	HP 360A (700 MHz cutoff) HP 360B (1.2 GHz cutoff) HP 360C (2.2 GHz cutoff) HP 360D (4.1 GHz cutoff)	P,T

Table 1-3. Recommended Test Equipment (2 of 2)

Instrument Type	Critical Specifications	Suggested Model	Use*
Detectors (3)	Frequency: 100 MHz to 18 GHz	HP 11664A	P,T
Oscilloscope	Vertical Bandwidth: ⩾ 250 kHz	HP 182A/1801A/1820C	P,T
DC Current-Limited Power Supply	Voltage: adjustable to ± 15V Current: can be limited to 50 milliamperes	HP 721A	P,T
Audio Oscillator	Frequency: to 27.8 kHz Output: to 15 Vrms	HP 200A/B	T
Open-End Wrench	Thin 1/2 x 9/16-inch wrench	HP Part No. 8710-0877	Chng. Conn.

* P = Performance Testing, T = Troubleshooting

SECTION II
INSTALLATION

2-1. INTRODUCTION

2-2. This section contains information concerning initial inspection, preparation for use, mating connectors, storage, and shipment.

2-3. INITIAL INSPECTION

2-4. If the shipping container of cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The contents of the shipment should be as shown in Figure 1-1. Procedures for checking electrical performance are given in Section IV. If there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, notify the carrier as well as the Hewlett-Packard office. Keep the shipping materials for the carrier's inspection. The HP office will arrange for repair or replacement without waiting for claim settlement.

2-5. PREPARATION FOR USE

2-6. Selecting RF Input Connector

2-7. The RF Connector outer shell and inner conductor assembly may be replaced, thereby changing the type of RF connector. This can be done by the operator using a thin open-end wrench. Refer to the Service section of this manual, paragraph 8-13, for details.

2-8. Using APC-7 RF Connectors

2-9. Figure 2-1 shows the use of APC-7 connectors. Read the instructions of this figure before attempting to use APC-7 connectors.

2-10. Mating Connectors

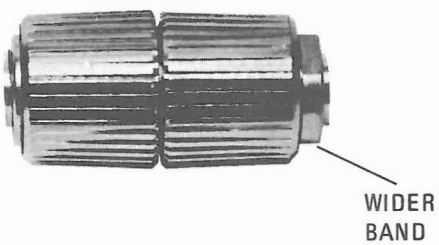
2-11. Connectors which mate with Type N connectors on the instrument are the corresponding Type N connectors whose dimensions conform to

To Connect:

1. On one connector, retract the coupling sleeve by turning the coupling nut counterclockwise until the sleeve and nut disengage.
2. On the other connector, fully extend the coupling sleeve by turning the coupling nut clockwise. To engage coupling sleeve and coupling nut when the sleeve is fully retracted, press back lightly on the nut while turning it clockwise.
3. Push the connectors firmly together, and thread the coupling nut of the connector with retracted sleeve over the extended sleeve
4. Do NOT tighten the other coupling nut since this will tend to loosen the electrical connection.

To Disconnect:

1. Loosen the coupling nut of the connector showing the wider gold band.



2. IMPORTANT: Part the connectors carefully to prevent striking the inner conductor contact.

Figure 2-1. Use of APC-7 Connectors

US military specification MIL-C-39012. Connectors which mate with APC-7 connectors are another APC-7 connector.

2-12. Operating Environment

2-13. Temperature. The instrument may be operated in temperatures from −25°C to +55°C.

NOTE

Frequency response drops off 0.03 dB/10°C from 20° to 55°C as operating temperature goes up.

2-14. Humidity. The instrument may be operated in environments with humidity up to 95%. However, the instrument should also be protected from temperature extremes which cause condensation within the instrument.

2-15. Altitude. The instrument may be operated at altitudes up to 25,000 feet.

2-16. STORAGE AND SHIPMENT

2-17. Environment

2-18. The instrument may be stored or shipped in environments within the following limits:

Temperature: . . . . . 0°C to +75°C
Humidity: . . . . . Up to 95%
Altitude: . . . . . Up to 25,000 feet

The instrument should also be protected from temperature extremes which cause condensation within the instrument.

2-19. Packaging

2-20. Original Packaging. Containers and materials identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, attach a tag indicating the type of service required, return address, model number, and full serial number. Also, mark the container FRAGILE to assure careful handling. In any correspondence, refer to the instrument by model number and full serial number.

2-21. Other Packaging. The following general instructions should be used for re-packaging with commercially available materials:

a. Wrap the instrument in heavy paper or plastic. If shipping to a Hewlett-Packard office or service center, attach a tag indicating the type of service required, return address, model number, and full serial number.

b. Use a strong shipping container. A double-wall carton made of 350-pound test material is adequate.

c. Use enough shock-absorbing material (3- to 4-inch layer) around all sides of the instrument to provide firm cushion and prevent movement inside the container.

d. Seal the shipping container securely.

SECTION III
OPERATION

3-1. INTRODUCTION

3-2. This section contains instructions concerning operation of the Model 11665B Detector.

3-3. FEATURES

3-4. Features of the Model 11665B are shown in Figure 3-1.

3-5. OPERATOR'S CHECK WITH 8755A

3-6. An Operator's Check of the 11665B is included in the Operator's Check for the Model 8755A given in the Operating and Service Manual for the Model 8755A Swept Amplitude Analyzer. An additional check, not using the Model 8755A is given in paragraph 3-9.

3-7. OPERATING INSTRUCTIONS

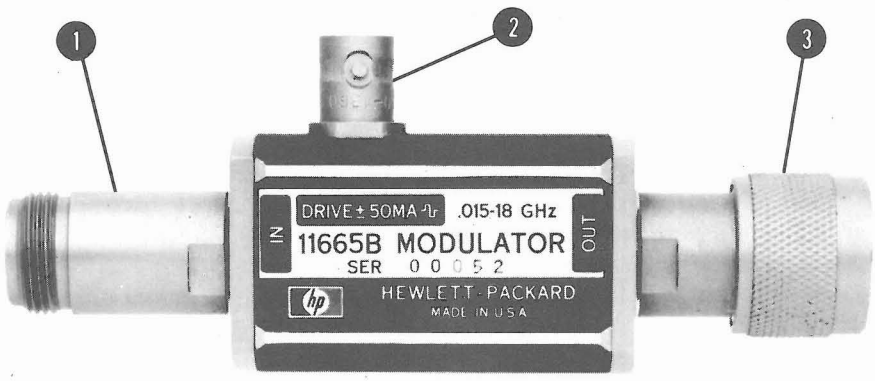
3-8. Operating instructions are given in the Operating and Service Manual for the Model 8755A Swept Amplitude Analyzer. A typical test setup using the Model 8755A is shown in Figure 3-2.

CAUTION

Do not apply more than +15 dBm RF Power or more than ± 10 volts dc voltage into the 11664A. If more than this power or voltage is applied, the 11664A may be damaged.

3-9. OPERATOR'S CHECK USING OTHER THAN 8755A

3-10. If a Hewlett-Packard Model 8755A Swept Amplitude Analyzer is not available for testing the Model 11665B Modulator, the Modulator may be tested in its normal operating setup. This check is particularly useful because it tests the 11665B under actual operating conditions. The only additional equipment needed is an oscilloscope and a crystal detector. Connect the crystal detector to the output of the setup in place of the normal load. Use an attenuator if the output is greater than the rated input of the crystal detector. Connect the oscilloscope to the output of the crystal detector. See Figure 3-3 for a typical setup.



1. RF Input Connector. The RF input signal is applied to this connector

2. Modulation Connector. A BNC type connector which will accept the modulating signal (up to 100 kHz).

3. RF Output Connector. The modulated RF signal appears at this connector.

NOTE

Type N connectors used on the 11665B have dimensions which conform to those given in US specifications MIL-C-39012A.

Figure 3-1. Model 11665B Modulator Features

Look at one complete cycle on the oscilloscope. Figure 3-4 shows a typical waveform which results from the sinewave modulation. The waveform may vary from this waveform depending upon the type of modulation used. The rounded risetime curve and diode-biasing voltage "wiggle" around zero volts are normal. The exact waveform which is normal for a particular application will vary with the application.

NOTE

It is recommended that this test be performed on the Modulator initially so that a normal modulation envelope will be noted. The permissible variation in the envelope will vary with the particular application, so no description which will cover all applications can be given here.

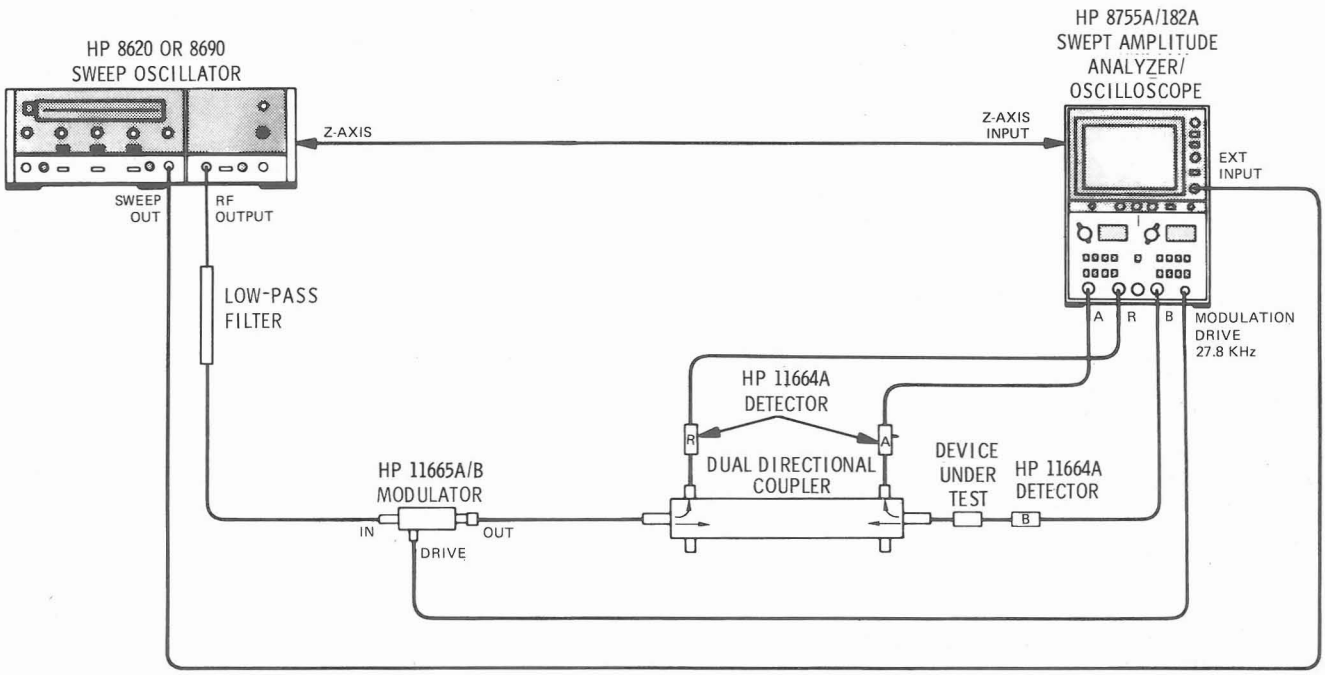


Figure 3-2. Model 8755A Typical Measurement Setup

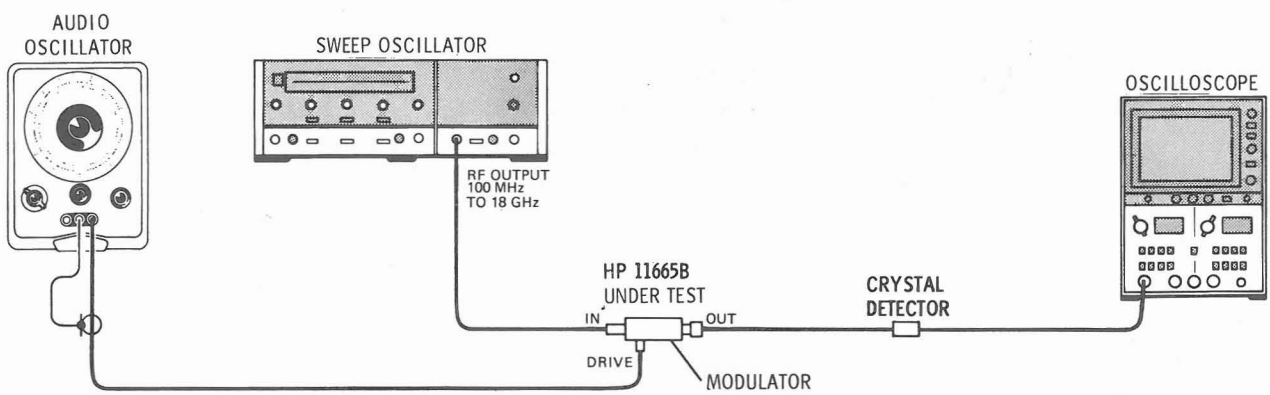


Figure 3-3. Operator's Check Using Other Than 8755A

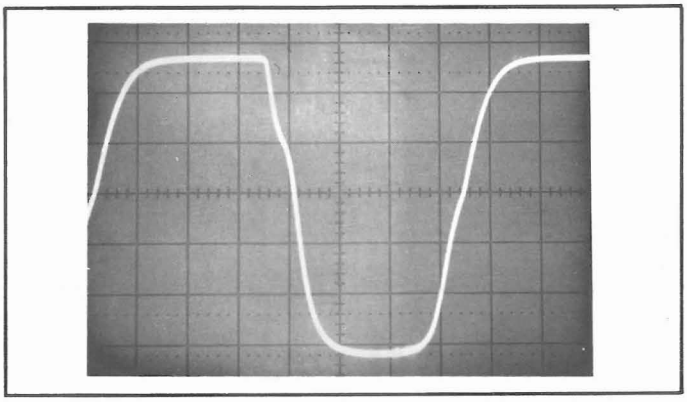


Figure 3-4. Typical Waveform of Modulation

SECTION IV
PERFORMANCE TESTS

4-1. INTRODUCTION

4-2. The procedures in this section test the instrument's electrical performance using the specifications of Table 1-1 as the performance standards. A simpler operational test is included in Section III under Operator's Check.

4-3. EQUIPMENT REQUIRED

4-4. Equipment required for the performance tests is listed in the Recommended Test Equipment table in Section I. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model.

4-5. TEST RECORD

4-6. Results of the performance tests may be tabulated on the Test Record at the end of the procedures. The Test Record lists all of the tested specifications and their acceptable limits. Test results recorded at incoming inspection can be used for comparison in periodic maintenance and troubleshooting and after repairs.

4-7. USE OF A DC CURRENT-LIMITED POWER SUPPLY IN PLACE OF A MODULATION SOURCE

4-8. Some of the following tests call for using a DC Current-Limited Power Supply in place of a modulation signal. This is necessary when testing specifications which call for either the ON or OFF condition of the 11665B. In order to hold the 11665B in either the ON or OFF condition 50 milliamperes of current must be supplied. If positive voltage is supplied, the 11665B will be ON; if negative voltage is supplied, the 11665B will be OFF. In either condition the 11665B must be protected against too much current. The maximum safe current is approximately 100 milliamperes. However, less than 25 milliamperes will not turn the 11665B either ON or OFF adequately.

CAUTION

Always supply power by increasing the voltage slowly. Do not just switch the voltage on and off. Damage to the 11665B may result from voltage overshoot if the supply is merely turned on and off.

4-9. To supply these voltages a DC Current-Limited Supply may be used. Set the over-current limit to approximately 55 milliamperes and increase the voltage slowly.

CAUTION

Always supply power by increasing the voltage slowly. Do not just switch the voltage on and off. Damage to the 11665B may result from voltage overshoot if the supply is merely turned on and off.

4-10. If a non-current limited supply must be used, a current limiting series resistor should be used. For a 10 volt supply, a series 180 ohm 1 watt resistor is adequate.

PERFORMANCE TESTS

4-11. RETURN LOSS MEASURED WITH MODEL 8755A

SPECIFICATION:

Return Loss (ON or OFF Condition)
(Model 8755A will test only to 0.1 GHz)
0.1 to 4 GHz: ≥15 dB (≤1.43 SWR)
4 to 8 GHz: ≥12 dB (≤1.67 SWR)
8 to 18 GHz: ≥8 dB (≤2.32 SWR)

DESCRIPTION:

This test will not be shown here since it is a standard return loss (reflection) test shown in the Operating and Service Manual for the 8755A. In this case the device under test is an 11665B, which must be biased on or off while being tested. Refer to paragraphs 4-7 through 4-10 in this manual for biasing instructions. Refer to the Operating and Service Manual for the 8755A for testing information.

4-12. INSERTION LOSS MEASURED WITH MODEL 8755A

SPECIFICATION:

Insertion Loss:

Frequency (GHz) *(Model 8755A will test only to 0.1 GHz)*	ON Condition	OFF Condition
0.1 to 4	≤ 3.2 dB	≥ 35 dB
4 to 8	≤ 3.8 dB	≥ 40 dB
8 to 12.4	≤ 4.3 dB	≥ 45 dB
12.4 to 18	≤ 5.0 dB	≥ 45 dB

DESCRIPTION:

This test will not be shown here since it is a standard insertion loss (transmission) test shown in the Operating and Service Manual for the 8755A. In this case the device under test is an 11665B, which must be biased on or off while being tested. Refer to paragraphs 4-7 through 4-10 in this manual for biasing instructions. Refer to the Operating and Service Manual for the 8755A for testing information.

4-13. MODULATOR DRIVE FEEDTHRU *

SPECIFICATION:

≤ 8 mV peak at 27.8 kHz from either input or output connector.

* When modulated by a Model 8755A.

PERFORMANCE TESTS

4-13. MODULATOR DRIVE FEEDTHRU (Cont'd)

DESCRIPTION:

The 11665B is connected to the Model 8755A and the feedthru voltage is measured on both the IN and OUT connectors.

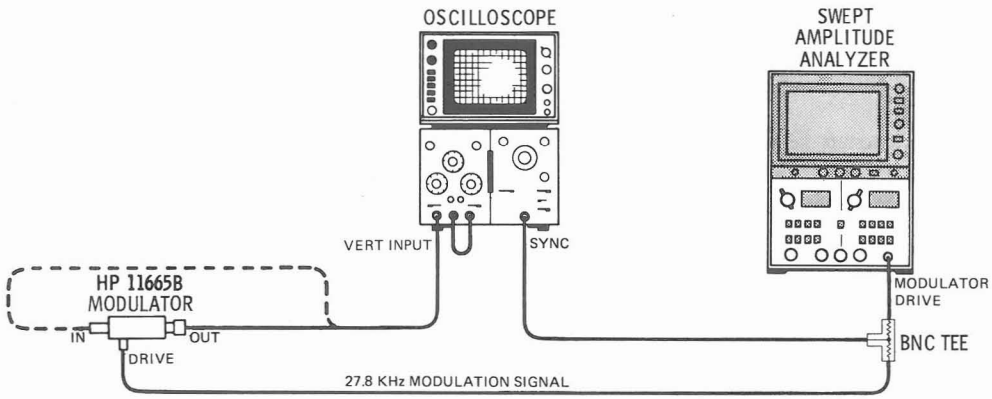


Figure 4-1. Modulation Drive Feedthru Test Setup

EQUIPMENT:

Modulator	HP 11665B
Swept Amplitude Analyzer Oscilloscope	HP 3755A/180
Oscilloscope	HP 182A/1802A/1820C (1802 is used with inputs cascaded)
BNC Tee	HP Part No. 1250-0781 (UG-274A/U)

PROCEDURE:

1. Connect the equipment as shown in Figure 4-1 with the Oscilloscope connected to the OUT terminal of the 11665B under test. Set 1802A for maximum cascaded gain (DISPLAY B, SYNC SOURCE A if input is to CHANNEL A).

2. Measure the peak voltage of the 27.8 kHz signal. This voltage should be $\leq$ 8 mV.

3. Connect the Oscilloscope to the opposite 11665A connector (IN connector).

4. Measure the peak voltage of the 27.8 kHz signal. This voltage should be $\leq$ 8 mV.

4-14. PERFORMANCE TESTS WITHOUT USING THE MODEL 8755A

4-15. The following tests will test the Model 11665B Modulator performance without using the Model 8755A Swept Amplitude Analyzer. Note that there is no test for Modulation Drive Feedthru, as this is specified only when driven by the 8755A.

PERFORMANCE TESTS

4-16. RETURN LOSS MEASURED WITHOUT MODEL 8755A

SPECIFICATION:

Return Loss (ON or OFF Condition)
.015 to .04 GHz: ≥10 dB (≤1.92 SWR)
.04 to 0.11 GHz: ≥15 dB (≤1.43 SWR)
(Model 8407A will test only to 0.11 GHz)

DESCRIPTION:

This test will not be shown here since it is a standard return loss (reflection) test shown in the Operating and Service Manual for the 8407A. In this case the device under test is an 11665B, which must be biased on or off while being tested. Refer to paragraphs 4-7 through 4-10 in this manual for biasing instructions. Refer to the Operating and Service Manual for the 8407A for testing information.

4-17. INSERTION LOSS MEASURED WITHOUT MODEL 8755A

SPECIFICATION:

Insertion Loss:

Frequency (GHz) *(Model 8407A will test only to 0.11 GHz)*	ON Condition	OFF Condition
.015 to .04	≤ 7.0 dB	≥ 35 dB
.04 to 0.11	≤ 3.2 dB	≥ 35 dB

DESCRIPTION:

This test will not be shown here since it is a standard insertion-loss (transmission) test shown in the Operating and Service Manual for the 8407A. In this case the device under test is an 11665B, which must be biased on or off while being tested. Refer to paragraphs 4-7 through 4-10 in this manual for biasing instructions. Refer to the Operating and Service Manual for the 8407A for testing information.

Table 4-1. Performance Record

Hewlett-Packard
Model 11665B
Modulator
Serial No. _____

Tested by _____

Date _____

Paragraph Number	Test	Min.	Actual	Max.
4-11.	**Return Loss Measured with Model 8755A**			
	(.015 to .04 GHz)	⩾ 10 dB	_____	
	(.04 to 4 GHz)	⩾ 15 dB	_____	
	(4 to 8 GHz)	⩾ 12 dB	_____	
	(8 to 18 GHz)	⩾ 8 dB		
4-12.	**Insertion Loss Measurement with Model 8755A**			
	ON CONDITION			
	(.015 to .04 GHz)		_____	⩽ 7.0 dB
	(.04 to 4 GHz)		_____	⩽ 3.2 dB
	(4 to 8 GHz)		_____	⩽ 3.8 dB
	(8 to 12.4 GHz)		_____	⩽ 4.3 dB
	(12.4 to 18 GHz)		_____	⩽ 5.0 dB
	OFF CONDITION			
	(0.1 to 2 GHz)	⩾ 35 dB	_____	
	(2 to 8 GHz)	⩾ 40 dB	_____	
	(8 to 18 GHz)	⩾ 45 dB	_____	
4-13.	**Modulator Drive Frequency**		_____	⩽ 8 mV peak
4-16.	**Return Loss Measured without Model 8755A**			
	(.015 to .04 GHz)	⩾ 10 dB	_____	
	(.04 to 4 GHz)	⩾ 15 dB	_____	
	(4 to 8 GHz)	⩾ 12 dB	_____	
	(8 to 18 GHz)	⩾ 8 dB	_____	
4-17.	**Insertion Loss Measurement withouth 8755A**			
	ON CONDITION			
	(.015 to .04 GHz)		_____	⩽ 7.0 dB
	(.04 to 4 GHz)		_____	⩽ 3.2 dB
	(4 to 8 GHz)		_____	⩽ 3.8 dB
	(8 to 12.4 GHz)		_____	⩽ 4.3 dB
	(12.4 to 18 GHz)		_____	⩽ 5.0 dB
	OFF CONDITION			
	(.015 to 4 GHz)	⩾ 35 dB	_____	
	(4 to 8 GHz)	⩾ 40 dB	_____	
	(8 to 18 GHz)	⩾ 45 dB	_____	

SECTION V
ADJUSTMENTS

5-1. The Hewlett-Packard Model 11665B Modulator has no adjustments or factory selected components.

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION

6-2. This section contains information for ordering parts. Table 6-1 lists abbreviations. Table 6-2 lists all replaceable parts in reference designation order. Other parts are not considered customer replaceable due to the special fixtures necessary for assembly. Table 6-3 contains the names and addresses that correspond to the manufacturer's code numbers. Figure 6-1 is a replaceable parts identification drawing for the RF Connectors. Note that the fixed parts of the center conductor assemblies are cemented together with "Loctite" cement, HP Part No. 0470-0013.

6-3. ABBREVIATIONS

6-4. Table 6-1 gives a list of abbreviations used in the parts list, schematics and throughout the manual. In some cases, two forms of the abbreviation are given, one all capital letters, and one partial or no capitals. This occurs because the abbreviation in the parts list are always all capitals. However, in the schematics and other parts of the manual, other abbreviation forms are used with both lower case and capital letters.

6-5. REPLACEABLE PARTS LIST

6-6. Table 6-2 is the list of replaceable parts and is organized as follows:

a. Replaceable parts in alpha-numeric order by reference designation.

b. Typical manufacturer of the part in a five-digit code.

c. Manufacturer code number for the part.

6-7. ORDERING INSTRUCTIONS

6-8. To order a part listed in the replaceable parts table, quote the Hewlett-Packard part number, indicate quantity required, and address the order to the nearest Hewlett-Packard office.

6-9. To order a part that is not listed in the replaceable parts table, include the instrument model number, instrument serial number, and description and function of the part, and the number of parts required. Address the order to the nearest Hewlett-Packard office.

Table 6-1. Reference Designators and Abbreviations

REFERENCE DESIGNATORS

A . . . . . assembly	CR . . . . . diode	L . . . . . inductor	R . . . . . resistor
C . . . . . capacitor	J . . . . . jack	P . . . . . plug	W . . . . . cable

ABBREVIATIONS

CONN . . . . . connector	H . . . . . henries	M . . . . . milli = 10^{-3}	N . . . . . nano = 10^{-9}
F . . . . . farads	Hz . . . . . Herta	MEG . . . . . meg = 10^{6}	P . . . . . pico = 10^{-12}
FXD . . . . . fixed	K . . . . . kilo = 1000	MFR . . . . . manufacturer	RF . . . . . radio frequency
G . . . . . giga = 10^{9}	LOG . . . logarithmic taper	MHz . . . . . mega Hertz	μ . . . . . micro = 10^{-6}

Table 6-2. Replaceable Parts

Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
J 1	11665-60008		INPUT CONNECTOR(FEMALE TYPE-N JACK) (FOR OPTIONS 011 AND 013). CONSISTS OF THE FOLLOWING PARTS:	28480	11665-60008
	1250-0914	2	BODY:RF CONNECTOR	02660	131-150
	1250-0915	2	CONTACT:RF CONNECTOR	02660	131-149
	5020-3297	5	CONTACT:SLIDING	28480	5020-3297
	1460-0526	5	SPRING:COMPRESSION	00000	OBD
	5020-3296	5	CONDUCTOR:CENTER CARTRIDGE ADAPT	28480	5020-3296
	5040-0306	5	INSULATOR	28480	5040-0306
			NOTE APPLY SMALL AMOUNT OF TYPE A "LOCTITE" HP PART NO. 0470-0013 TO THREADS OF CONTACT OR CONTACT ASSEMBLY. WHEN PROPERLY ASSEMBLED ALL FINGERS OF SLIDING CONTACT SHOULD BE INSIDE THE CENTER CONDUCTOR. ASSEMBLY CAN BE MADE EASIER BY WRAPPING A PIECE OF FINE WIRE AROUND THE CONTACT FINGERS.		
J 1	11665-60009		INPUT CONNECTOR(MALE TYPE-N PLUG) (FOR OPTIONS 021, 022, & 023.) CONSISTS OF THE FOLLOWING PARTS:	28480	11665-60009
	1250-0916	2	BODY:RF CONNECTOR SERIES APC-N	02660	131-148
	1250-0917	2	CONTACT:RF CONNECTOR SERIES APC-N	02660	131-147
	1250-0016	2	RING:RF CONNECTOR SERIES N	02660	82-113B-6
	1250-0918	2	NUT:RF CONNECTOR	02660	131-135
	5020-3297		CONTACT:SLIDING	28480	5020-3297
	1460-0526		SPRING:COMPRESSION	00000	OBD
	5020-3296		CONDUCTOR:CENTER CARTRIDGE ADAPT	28480	5020-3296
	5040-0306		INSULATOR	28480	5040-0306
			NOTE APPLY SMALL AMOUNT OF TYPE A "LOCTITE" HP PART NO. 0470-0013 TO THREADS OF CONTACT OR CONTACT ASSEMBLY. WHEN PROPERLY ASSEMBLED ALL FINGERS OF SLIDING CONTACT SHOULD BE INSIDE THE CENTER CONDUCTOR. ASSEMBLY CAN BE MADE EASIER BY WRAPPING A PIECE OF FINE WIRE AROUND THE CONTACT FINGERS.		
J 2	11665-60008		OUTPUT CONNECTOR(FEMALE TYPE-N JACK) (FOR OPTIONS 011 AND 021.) CONSISTS OF THE FOLLOWING PARTS:	28480	11665-60008
	1250-0914		BODY:RF CONNECTOR	02660	131-150
	1250-0915		CONTACT:RF CONNECTOR	02660	131-149
	5020-3297		CONTACT:SLIDING	28480	5020-3297
	1460-0526		SPRING:COMPRESSION	00000	OBD
	5020-3296		CONDUCTOR:CENTER CARTRIDGE ADAPT	28480	5020-3296
	5040-0306		INSULATOR	28480	5040-0306
			NOTE APPLY SMALL AMOUNT OF TYPE A "LOCTITE" HP PART NO. 0470-0013 TO THREADS OF CONTACT OR CONTACT ASSEMBLY. WHEN PROPERLY ASSEMBLED ALL FINGERS OF SLIDING CONTACT SHOULD BE INSIDE THE CENTER CONDUCTOR. ASSEMBLY CAN BE MADE EASIER BY WRAPPING A PIECE OF FINE WIRE AROUND THE CONTACT FINGERS.		
J 2	11665-60009		OUTPUT CONNECTOR(MALE TYPE-N PLUG) (FOR OPTION 022.) CONSISTS OF THE FOLLOWING PARTS:	28480	11665-60009
	1250-0916		BODY:RF CONNECTOR SERIES APC-N	02660	131-148
	1250-0917		CONTACT:RF CONNECTOR SERIES APC-N	02660	131-147
	1250-0016		RING:RF CONNECTOR SERIES N	02660	82-113B-6

See introduction to this section for ordering information

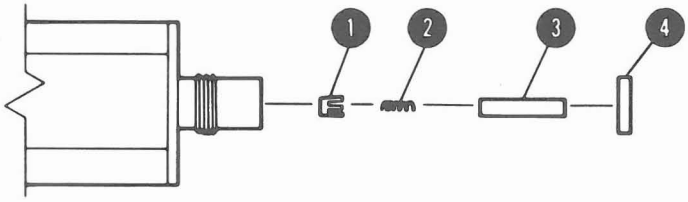
Table 6-2. Replaceable Parts

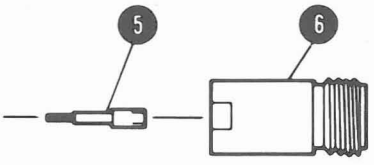
Reference Designation	HP Part Number	Qty	Description	Mfr Code	Mfr Part Number
J 2 (CONT'D)	1250-0918		NUT:RF CONNECTOR	02660	131-135
	5020-3297		CONTACT:SLIDING	28480	5020-3297
	1460-0526		SPRING:COMPRESSION	00000	OBD
	5020-3296		CONDUCTOR:CENTER CARTRIDGE ADAPT	28480	5020-3296
	5040-0306		INSULATOR	28480	5040-0306
			NOTE		
			APPLY SMALL AMOUNT OF TYPE A "LOCTITE" HP PART NO. 0470-0013 TO THREADS OF CONTACT OR CONTACT ASSEMBLY. WHEN PROPERLY ASSEMBLED ALL FINGERS OF SLIDING CONTACT SHOULD BE INSIDE THE CENTER CONDUCTOR. ASSEMBLY CAN BE MADE EASIER BY WRAPPING A PIECE OF FINE WIRE AROUND THE CONTACT FINGERS.		
J 2	11665-60010		OUTPUT CONNECTOR(APC-7) (FOR OPTIONS 013, 023 AND 033). CONSISTS OF THE FOLLOWING PARTS:	28480	11665-60010
	1250-0909	1	ASSY:RF CONNECTOR APC-7 TYPE	02660	131-1057
	1250-0816	1	CONTACT:RF CONNECTOR FOR APC-7 CONNECT	02660	131-1054
	5020-3297		CONTACT:SLIDING	28480	5020-3297
	1460-0526		SPRING:COMPRESSION	00000	OBD
	5020-3296		CONDUCTOR:CENTER CARTRIDGE ADAPT	28480	5020-3296
	5040-0306		INSULATOR	28480	5040-0306
			NOTE		
			APPLY SMALL AMOUNT OF TYPE A "LOCTITE" HP PART NO. 0470-0013 TO THREADS OF CONTACT OR CONTACT ASSEMBLY.		
			WHEN PROPERLY ASSEMBLED ALL FINGERS OF SLIDING CONTACT SHOULD BE INSIDE THE CENTER CONDUCTOR. ASSEMBLY CAN BE MADE EASIER BY WRAPPING A PIECE OF FINE WIRE AROUND THE CONTACT FINGERS.		
P1			DRIVE CONNECTOR FOR ALL OPTIONS CONSISTS OF THE FOLLOWING PARTS:		
	1250-0532	1	CONNECTOR:RF	28480	1250-0532
	1460-1285	1	SPRING:COMPRESSION 0.057" OD 0.190" LG	00000	OBD
	08491-2009	1	CONTACT:SLIDING	28480	08491-2009
			CAUTION		
			DO NOT ATTEMPT TO REMOVE THE DRIVE CONNECTOR(P1) WITHOUT FIRST READING PARAGRAPH 8-17. THE MODULATOR MAY BE DAMAGED.		
	7124-0656		LABEL	28480	7124-0656

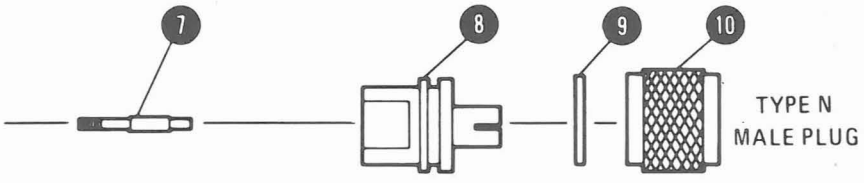
Table 6-3. Manufacturers Code List

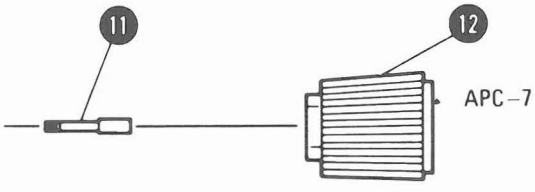
MFR NO.	MANUFACTURER NAME	ADDRESS	ZIP CODE
00000	U.S.A. COMMON	ANY SUPPLIER OF U.S.A.	
02660	AMPHENOL CORP.	BROADVIEW, ILL.	60153
28480	HEWLETT-PACKARD CO. CORPORATE HQ	YOUR NEAREST HP OFFICE	

See introduction to this section for ordering information









EACH RF CONNECTOR CONSISTS OF:

1. Sliding Contact
2. Spring
3. Center Conductor
4. Insulator

PLUS ONE OF THE FOLLOWING PACKAGES

Type N Female Jack Connector Package

(Opt. 011, 013, & 021) Consisting of:

5. Contact
6. Body

Type N Male Plug Connector Package

(Opt. 021, 022, & 023) Consisting of:

7. Contact
8. Body
9. Ring
10. Nut

APC-7 Connector Package

(Opt. 013 & 023) Consisting of:

11. Contact
12. Coupling Nut Assembly

Figure 6-1. RF Connectors Replaceable Parts

SECTION VII
MANUAL CHANGES

7-1. INTRODUCTION

7-2. This section normally contains information for adapting this manual to instruments for which the content does not apply directly. Since this manual does apply directly to instruments having serial numbers listed on the title page, no change information is given here. Refer to INSTRUMENTS COVERED BY MANUAL in Section I for additional important information about serial number coverage.

SECTION VIII
SERVICE

8-1. INTRODUCTION

8-2. This section contains troubleshooting and repair information. The general organization of this section is:

a. Test covering repair procedures.

b. A Service Sheet containing principles of operation and a schematic diagram.

8-3. PRINCIPLES OF OPERATION

8-4. A circuit description keyed to the schematic diagram is given opposite the schematic. This is helpful in understanding each major circuit function.

8-5. TROUBLESHOOTING

8-6. Troubleshooting the Model 11665B Modulator consists of performing the Operator's Check and the Performance Tests. Refer to Troubleshooting Procedures, paragraph 8-19, for further details.

8-7. RECOMMENDED TEST EQUIPMENT

8-8. Equipment recommended to test and maintain the 11665B is listed in Table 1-3. Special tools for servicing the 11665B are also listed.

8-9. REPAIR

8-10. This section gives detailed step-by-step repair procedures for some individual components where special care is necessary.

8-11. RF Connector Replacement

8-12. Several standard HP RF Input connectors (Figure 8-1) may be used on the 11665B. The following connectors are available:

Connector Type
Type N Male Plug
Type N Female Jack
APC-7

8-13. To replace the connector outer shell and inner conductor assembly proceed as follows:

a. With a thin 1/2-inch (APC-7) or 7/16-inch (Type N) open-end wrench, loosen the connector outer shell on the 11665B. A 1/2- x 9/16-inch thin open-end wrench can be ordered as HP Part No. 8710-0877.

b. Carefully remove the outer shell and inner conductor assembly.

CAUTION

Do NOT disassemble the center conductor assembly. If the sliding contact is removed, reassembly is difficult.

c. Insert new center conductor assembly in the RF connector shell. Push down on the center conductor to seat the center conductor assembly.

d. Screw the corresponding outer shell assembly on the connector mounting.

e. Tighten outer shell assembly with the open-end wrench used for disassembly.

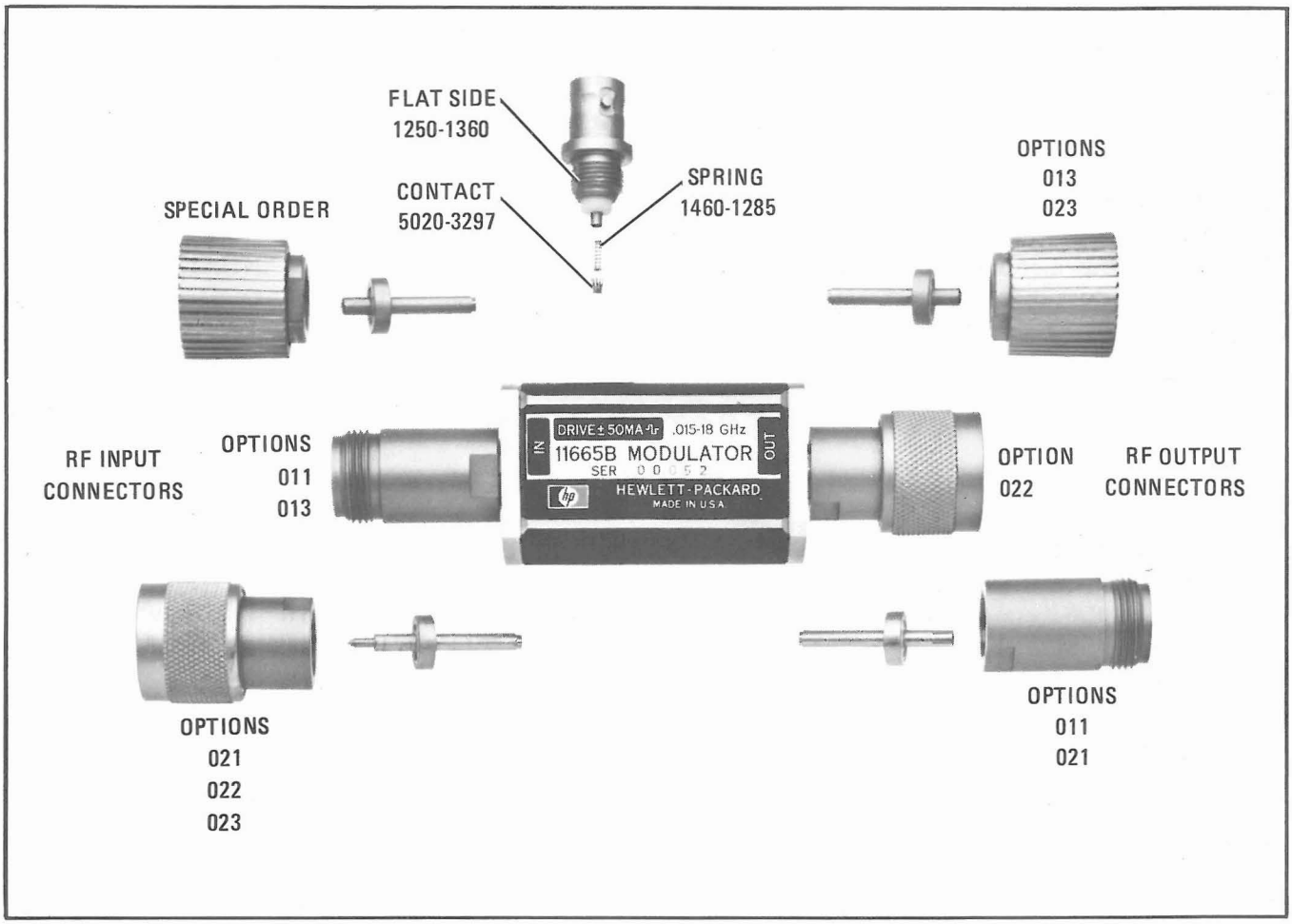


Figure 8-1. Model 11665B Connectors

8-14. Replacing Center Conductor Contact in APC-7 Connectors

8-15. Through wear or damage, the contact in the center conductor may need replacing. It is a small four-pronged collet which snaps into a recess in the center conductor. This contact is normally held in by the spring-action of the four progns. With a magnifying glass examine this contact to determine if it needs replacement. DO NOT REMOVE THIS CONTACT FOR INSPECTION (it may be damaged by removing). The contact should be free of burrs or wear and the prongs should be equally spaced. If the contact is removed do NOT re-use it (it may be damaged by removal). This contact is Amphenol* Part Number 131-129 and HP Part No. 1260-0907. If it needs replacement proceed as follows:

a. Place the instrument so the connector faces down.

b. Tap the connector lightly and the contact should now protrude slightly. Insert the centering pin of the HP contact extractor, part number 5060-0236, with the jaws open. If this tool is not available, an ordinary draftsman's mechanical pencil may be used.

c. Allow the jaws on the tool used to close and pull straight away from the connector without twisting.

d. Snap in a new contact by pushing a new contact in place.

8-16. BNC CONNECTOR REPLACEMENT

8-17. In addition to replacing the RF Input connectors, which has been given in paragraph 8-11, the only field repair procedure is the BNC connector replacement. To replace the BNC connector, proceed as follows:

* Amphenol RF Division, Danbury, Connecticut.

Disassembly

CAUTION

Remove only the screw instructed. Do NOT remove both screws in the IN connector. If both screws are removed the 11665B will be damaged and must be returned to the factory for repair.

a. Remove only the single pozi-drive screw nearest the BNC connector.

b. Insert a 0.05-inch across-the-flats hex wrench into the hole left when the screw in step (a) was removed. Turn the hex wrench counter-clockwise to loosen.

c. Remove the BNC connector carefully so as not to lose the contact and spring in the BNC center conductor assembly. See Figure 8-1.

Reassembly

d. Install the spring and sliding contact in the new connector. (Assembly can be made easier by wrapping a piece of fine wire around the contact fingers.)

e. Position the new connector with the flat side towards the setscrew.

CAUTION

Do not insert the connector and turn. The 11665B may be damaged and may have to be returned to the factory for repair if this is done.

f. Push down on the BNC connector firmly and tighten setscrew firmly.

g. Replace pozi-drive screw previously removed in step a.

8-18. For any other repair, return the 11665B to the factory. Do not attempt to take the 11665B apart for repair. If this is done the 11665B most likely will be damaged. Special fixtures are necessary to reassemble the 11665B.

8-19. TROUBLESHOOTING PROCEDURES

8-20. Simple ohmmeter checks will not adequately check the Model 11665B because more than one diode is used with either polarity input on any of the connectors.

8-21. Trouble in the 11665B will probably first be encountered when attempting normal operation. If trouble is encountered, perform the Operator's Check, Figure 3-3, first. If the modulation waveform is not typical for the particular application, go to the Performance Tests. If the 11665B will not pass the Performance Tests, inspect the connector. If there is no obvious fault with the connectors, return the 11665B to the factory for repair. If the 11665B does pass the Performance Tests, check the system in which it is used for trouble.

8-22. PRINCIPLES OF OPERATION

8-23. The Modulator is a two-state absorptive type, operating with a single current drive. It divides naturally into three sections, a blocking capacitor, an operational module, and a 15 MHz high-pass filter. Blocking capacitors of the disc ceramic type are found on each end of the modulator. The operational module is a hermetically-sealed PIN-diode absorptive switch. The 15 MHz high-pass filter is a three-element Chebyshev design. The filter is necessary to prevent the modulation drive from being applied to the RF line. Without the filter the drive feedthrough could be as high as one or two volts, which should show up as an increase in system noise level, and it would also decrease the instrument's dynamic range. It could, of course, also change the bias level of active devices in the tested network, or even destroy them.

8-24. The Modulator operates normally in two states: low loss (+50 mA) and high loss (—50 mA). During transition between states the impedance match gets no worse than 3:1 SWR and the insertion loss at zero current is about 6 dB. This occurs when all the diodes are off, leaving only the two 47-ohm resistors in series with the load.

8-25. In the low-loss state, the series diodes are conducting, while the two shunt diodes are back-biased. The series diodes bypass the 47-ohm resistors; the shunt diodes are out of the circuit except for their capacitance, which is part of the low-pass filter. The result is a low-loss path through the module.

8-26. In the high-loss state, the shunt diodes are biased through R1. The voltage developed across this resistor back-biases the one series diode, CR1. The other series diode, CR4, is not back-biased but its barrier potential is sufficient so that the RF signal cannot forward bias this diode. At CR4 the RF signal is low because the module is in its high-loss state. The series diodes being effectively out of the circuit, the 47-ohm resistors now are grounded through the shunt diodes, and the circuit presents a good match.

8-27. The control current is not critical because the diodes are being used as switches, not as variable resistors as in some absorptive modulators.

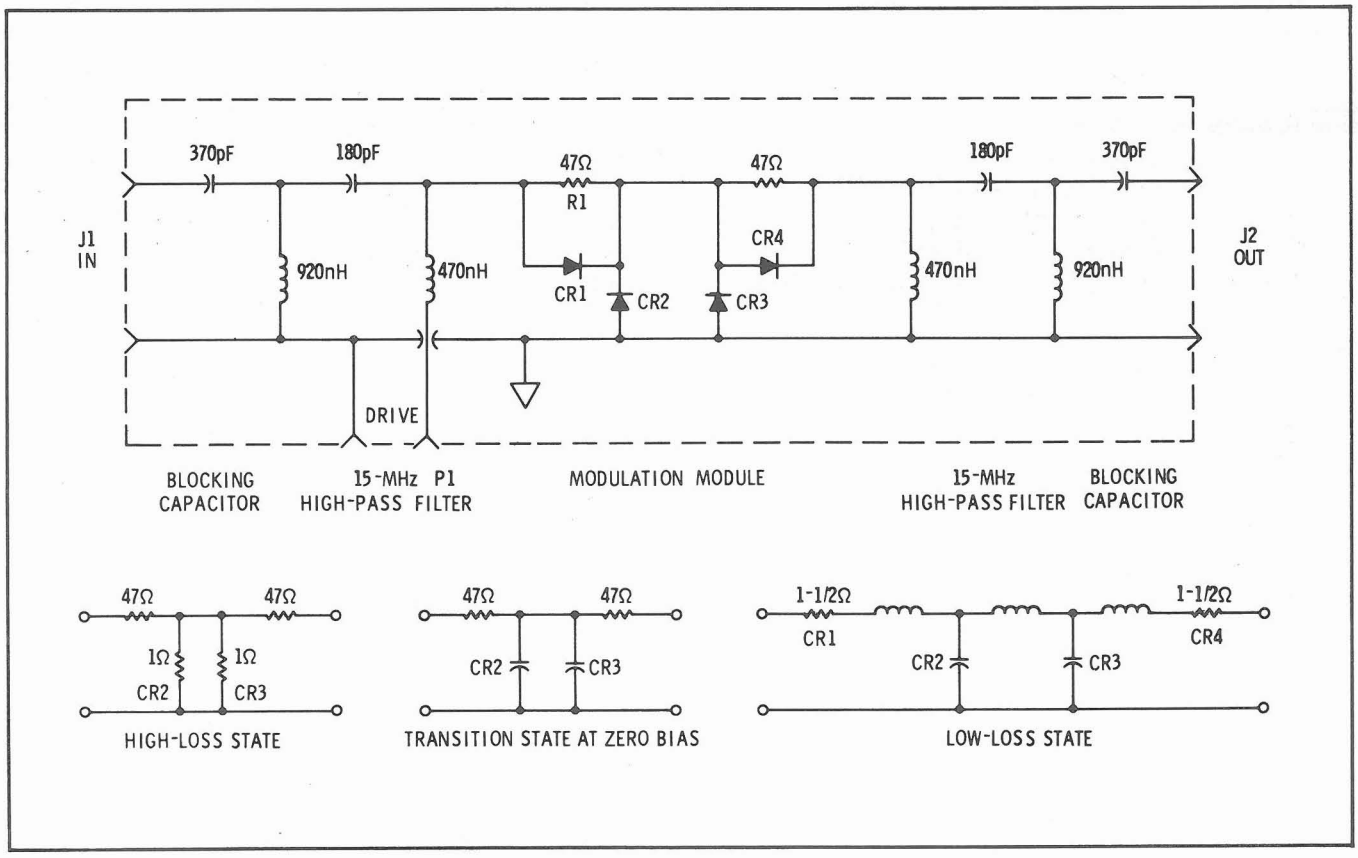


Figure 8-2. Model 11665B Modulator Schematic

HEWLETT · PACKARD

ELECTRONIC INSTRUMENTATION SALES AND SERVICE

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TWX: 810-726-2204

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Phoenix 85034
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TWX: 910-951-1330

2424 East Aragon Rd.
Tucson 85706
Tel: (602) 889-4661

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Fullerton 92631
Tel: (714) 870-1000
TWX: 910-592-1288

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TWX: 910-499-2170

6515 Arizona Place
Los Angeles 90045
Tel: (213) 776-7500
TWX: 910-328-6148

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TWX: 910-373-1280

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TWX: 910-367-2092

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Tel: (714) 279-3200
TWX: 910-335-2000

COLORADO
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Englewood 80110
Tel: (303) 771-3455
TWX: 910-935-0705

CONNECTICUT
12 Lunar Drive
New Haven 06525
Tel: (203) 389-6551
TWX: 710-465-2029

FLORIDA
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Ft. Lauderdale 33307
Tel: (305) 731-2020
TWX: 510-955-4099

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6177 Lake Ellenor Dr.
Orlando, 32809
Tel: (305) 859-2900
TWX: 810-850-0113

GEORGIA
P.O. Box 28234
450 Interstate North
Atlanta 30328
Tel: (404) 436-6181
TWX: 810-766-4890

HAWAII
2875 So. King Street
Honolulu 96814
Tel: (808) 955-4455

ILLINOIS
5500 Howard Street
Skokie 60076
Tel: (312) 677-0400
TWX: 910-223-3613

INDIANA
3839 Meadows Drive
Indianapolis 46205
Tel: (317) 546-4891
TWX: 810-341-3263

IOWA
1902 Broadway
Iowa City 52240
Tel: (319) 338-9466
Night: (319) 338-9467

LOUISIANA
P. O. Box 840
3239 Williams Boulevard
Kenner 70062
Tel: (504) 721-6201
TWX: 810-955-5524

MARYLAND
6707 Whitestone Road
Baltimore 21207
Tel: (301) 944-5400
TWX: 710-862-9157

20010 Century Blvd.
Germantown 20767
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Rua Frei Caneca 1119
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Bogota, 1 D.E.
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Cable: AARIS Bogota
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COSTA RICA
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Apartado 10159
San José
Tel: 21-86-13
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Laboratorios de Radio-Ingeniería
Calle Guayaquil 1246
Post Office Box 3199
Quito
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Cable: HORVATH Quito

EL SALVADOR
Electronic Associates
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San Salvador, El Salvador C.A.
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Ave. Manuel Espinosa No. 13-50
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San Juan Electronics, Inc.
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Ponce de Leon 154
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Switzerland
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Cable: HEWPACKSA Geneva
Telex: 2 24 86

AFRICA, ASIA, AUSTRALIA

Hewlett-Packard
Export Trade Company
3200 Hillview Ave.
Palo Alto, California 94304
Tel: (415) 493-1501
TWX: 910-373-1267
Cable: HEWPACK Palo Alto
Telex: 034-8300, 034-8493

E 4/74

MANUAL IDENTIFICATION

Model Number: 11665B
Date Printed: July 1973
Part Number: 11665-90011

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections

Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix or Number	Make Manual Changes

Serial Prefix or Number	Make Manual Changes

► NEW ITEM

ERRATA

Page 1-3, Table 1-2:

Extend ON CONDITION Insertion Loss graph (upper graph) LIMITS curve from 12.0 to 18.0 GHz along the 5 dB scale line.

Page 1-4, Table 1-3:

Change lower Frequency limit of all items in Critical Specifications column to 15 MHz.

Under Sweep Oscillator Suggested Model add 86210A (3 to 350 MHz).

Change Dual Directional Instrument Type to Dual Directional Coupler/Directional Bridge and add HP 8721A (15 to 110 MHz) to Suggested Models shown.

Page 1-5/1-6, Table 1-3:

Under Detectors (3), change lower Frequency limit in Critical Specifications column to 15 MHz.

Under Oscilloscope Suggested Models add 1802A.

Page 2-2, paragraph 2-13:

Change temperature range to 0°C to +55°C.

NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

6 March 1974

2 Pages

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ERRATA (Cont'd)

Page 2-2, paragraph 2-18:
Change temperature range to −40°C to +75°C.

Page 4-2, paragraph 4-11:
Change SPECIFICATION to
Return Loss (ON or OFF Condition)
.015 to 0.04 GHz: ⩾10 dB (⩽1.92 SWR)
0.04 to 4 GHz: ⩾15 dB (⩽1.43 SWR)
4 to 8 GHz: ⩾12 dB (⩽1.67 SWR)
8 to 18 GHz: ⩾ 8 dB (⩽2.32 SWR)

Page 4-2, paragraph 4-12:
Change SPECIFICATION to

Frequency (GHz)	ON Condition	OFF Condition
0.015 to 0.04	⩽7.0 dB	⩾35 dB
0.04 to 4	⩽3.2 dB	⩾35 dB
4 to 8	⩽3.8 dB	⩾40 dB
8 to 12.4	⩽4.3 dB	⩾45 dB
12.4 to 18	⩽5.0 dB	⩾45 dB

Page 4-3, Figure 4-1:
The BNC TEE should be shown as a straight-through TEE, not a power splitter. Use of a power splitter will give a wrong indication.

Page 4-4, paragraph 4-17:
Change to read as follows:
SPECIFICATION:

Frequency (GHz)	ON Condition	OFF Condition
Model 8407A		
0.015 to 0.04	⩽7.0 dB	⩾35 dB
0.04 to 0.11	⩽3.2 dB	⩾35 dB
Model 8410A		
0.11 to 4	⩽3.2 dB	⩾35 dB
4 to 8	⩽3.8 dB	⩾40 dB
8 to 12.4	⩽4.3 dB	⩾45 dB
12.4 to 18	⩽5.0 dB	⩾45 dB

DESCRIPTION:
This test will not be shown here since it is a standard insertion-loss (transmission) test shown in the Operating and Service Manual for the Model 8407A or 8410A. In this case the device under test is an 11665B, which must be biased on or off while being tested. Refer to paragraphs 4-7 through 4-10 in this manual for biasing instructions. Refer to the Operating and Service Manual for the 8407A or 8410A for testing information.

Page 8-2, Figure 8-1:
Change top BNC connector part number to 1250-0532.

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